# Cationization Technique for Polyethylene glycol (PEG) with Argon Cluster Ion Beam connected with AccuToF Mass Analyzer

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The gas cluster ion beam (GCIB) are wildly used in secondary ion mass spectrometry (SIMS) in recent years [1,2,3]. Large intact molecular ions can be sputtered and detected when the GCIB bombards an organic, biological and polymer samples. However, the sputtered secondary ion are decrease when increased molecular mass ( more than 500 u) therefore an increasing sensitivity at high mass regions is inevitable. Our previous work, the PEG (3,000 Da)-mixed trifluoroacetic acid sodium salt (NaTFA) sample was investigated the secondary ions distribution as chain length. The secondary ions of mass regions more than 1,000 u were increased with sodium attached molecules (sodium cationization) $[M+Na]^+$ when comparison without mixed NaTFA. From the mass spectrum, the doubly and triply charged ions could be observed. In this work, the PEG sample with the chemical formula of $C_{2n}H_{4n+2}O_{n+1}$ was used in the analysis and investigation of mass spectra. The PEG (1,000 : 2,000 : 3,000 Da)-mixed cesium bromide (CsBr) sample at a molar ratio of 1:8 was prepared by the spin-coating technique.

For mass analysis is used an Argon-gas cluster ion beam (Ar-GCIB) (a primary energy of 10 keV and about 650 pA beam current) connected with AccuToF mass analyzer. The accumulation time was 100 s and the primary ion dose was about $1.6\times10^{14}$ ions/cm$^2$. From the experiment, the MS mass spectra could be measured to 4,000 Da. The MS mass spectrum and secondary ion mass distribution are shown in Fig. 1. The cesium cationization $[M+Cs]^+$ is the dominant peak in the regions of *m/z* 1,000, 2,000 and 3,000 as presented by the molecular mass distribution (Fig. 1 (b)). Very astonishing and interesting, the $[M+Cs]^+$ intensity around region of *m/z* 3,000 is more than region of *m/z* 2,000 because sensitivity at high mass is lower than that at low mass, even in case of NaTFA mixed PEG sample. The mechanism of cationization in the polymer sample will be investigated, presented and discussed.

Keywords: GCIB, PEG, NaTFA, CsBr, Cationization

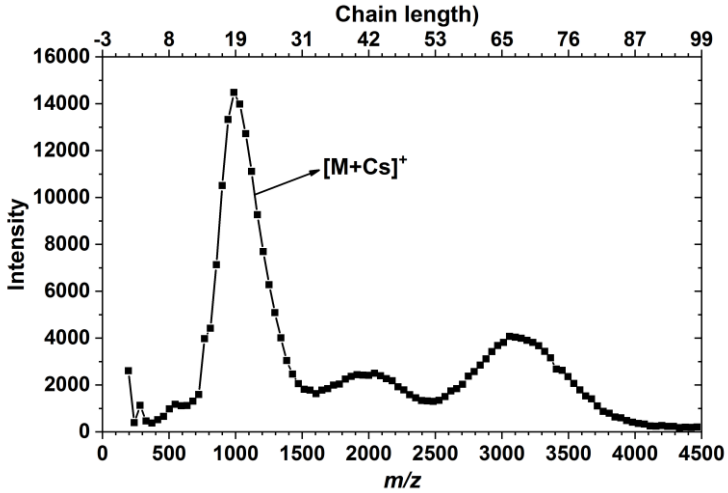


Fig.1 The MS mass spectrum (a) and integrated peak area (b) of the PEG sample. The $[M+Cs]^+$ presents the molecular cesium cationization distribution.

[Reference] [1] C. M. Mahoney, Mass Spectrom Rev. 1-47, (2009)
[2] A. Wucher, Appl Surf Sci 252, 6482-6489 (2006).
[2] K. Ichiki, S. Ninomiya, Y. Nakata, Y. Honda, T. Seki, T. Aoki, and J. Matsuo, Appl Surf Sci 255, 1148-1150 (2008).